## Hydrogeochemical Assessment of Groundwater Quality in N'kapa, Littoral Region Cameroon: Implications for Sustainable Domestic, Agro-Industrial, and Irrigation Use.

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This study investigates the hydrogeochemical characteristics of groundwater in N'kapa, Cameroon, with a focus on its suitability for domestic, agro-industrial, and irrigation purposes. Employing hydrogeochemical tools and physicochemical parameters, including Gibbs diagrams, Piper diagrams, Durov diagrams, and water quality indices, 20 groundwater samples were collected from boreholes for analysis.

Results indicate that Electrical Conductivity (EC), Total Hardness (TH), and Total Dissolved Solids (TDS) fall within WHO-permissible ranges. However, pH levels consistently exceed WHO limits. Major ion concentrations generally adhere to guidelines, except for nitrate (NO3-) levels, which exceed limits in 15% of the samples. The abundance sequence of major ions reveals Na<sup>+</sup> > Ca<sup>2+</sup> > K<sup>+</sup> > Mg<sup>2+</sup>,Cl<sup>-</sup> > HCO<sub>3</sub><sup>-</sup> > SO<sub>4</sub><sup>2-</sup> > NO<sub>3</sub><sup>-</sup>. Hydrogeochemical processes involve simple dissolution and ion exchange, contributing to ionic content from ion exchange and rock weathering. Dominant water types are Na-Cl (80%) and Mixed Ca-Mg-Cl (20%).

Groundwater quality assessment for domestic and drinking purposes using parameters like pH, EC, TDS, TH, and groundwater quality index (GWQI) indicates that 90% of samples have good quality, except for pH levels. For agroindustrial purposes, parameters such as residual sodium carbonate (RSC), plasticity index (PI), magnesium absorption ratio (MAR), and sodium absorption ratio (SAR) suggest suitability, though soluble sodium percentage (SSP) and Kelly's ratio (KR) exceed set limits in 55% and 70% of samples, respectively. The Wilcox diagram suggests excellent to good suitability for irrigation.

Given N'kapa's status as a major agro-industrial zone in Cameroon and Central Africa, reliant on extensive irrigationbased agricultural initiatives, these findings have significant implications. Further research into the biological composition of groundwater in the area is recommended for a comprehensive understanding and sustainable management.

Location	Water	Temp	pH	EC	TDS	$Na^+$	$\mathbf{K}^*$	Ca <sup>+</sup>	Mg <sup>2+</sup>	Cl <sup></sup>	$HC0_3^-$	NO <sub>3</sub>	SO <sub>4</sub> -
	Type			(uS/cm)									
Muyenge Quartier	BH01	28.8	5.35	62	31	7.6	0.7	1.2	0.2	2.7	7.3	16.9	0.8
Muyenge Quartier	BH02	28.9	4.44	226	113	4.6	6.2	1.6	1.3	35.2	14.6	4.5	1.7
Muvenge Quartier	BH03	30.7	5.4	7	3	0.6	0.2	0.2	0.1	0.9	7.3	1.1	0.8
Auyenge Quartier 1	BH04	30.7	5.06	52	26	3.1	1.9	1.2	0.6	6.3	9.8	8.6	0.8
Mayenge Quartier2	BH05	33.9	5.49	7	3	1.0	0.2	0.2	0.1	0.8	4.9	1.7	0.8
Auvenge Quartier 5	BH05	31	5.43	7	3	0.3	0.3	0.3	0.1	0.7	9.8	0.5	0.9
Bonaleya Demier	BH07	32.6	5.59	5	2	0.4	0.4	0.3	0.1	0.8	4.9	0.6	1.2
Muyenge Block 2	BH08	30.2	5.73	11	5	1.1	0.2	0.9	0.1	0.6	9.8	2.5	1.1
Muvenge Block 3	BH09	30.4	5.85	5	2	0.7	0.2	0.3	0.1	0.8	7.3	1.1	1.0
Mundani	BH10	30.2	5.11	41	20	1.1	3.8	0.7	0.3	5.2	14.6	4.4	0.8
Carefou Smoke	BHII	30.8	5.24	67	33	9.2	1.2	0.8	0.5	4.1	4.9	22.8	0.9
Mundani	BH12	30.05	5.25	29	14	2.7	0.5	0.5	0.2	1.7	4.9	9.2	0.7
Nkolo	BH13	28.8	5.52	13	6	1.5	0.2	0.3	0.1	1.2	7.3	2.6	0.8
Quartier Nehang	BH14	28.7	4.97	201	100	18.2	6.0	3.4	1.8	11.0	4.9	68.9	1.1
Mundani	BH15	28.1	5.92	211	105	26.0	6.5	3.5	1.4	14.6	4.9	63.0	1.1
Tantion	BH16	28.8	5.62	27	13	2.3	0.7	1.7	0.3	3.1	4.9	3.8	1.2
Quartier Papa Etoo	BH17	28.5	5.55	17	8	1.2	1.1	1.4	0.3	2.5	4.9	1.4	1.3
Quartier Papa Etoo	BH18	28.4	5.04	113	56	12.4	3.9	2.2	1.0	6.4	4.9	36.0	1.0
Mundani	BH19	28.1	5.21	186	93	19.5	6.6	6.1	1.8	10.9	9.8	67.8	1.4
Mundani	BH20	28	5.49	30	15	4.7	0.2	0.3	0.1	1.8	7.3	8.0	0.7
Min		28	4.44	5	2	0.34	0.16	0.19	0.05	0.58	4.88	0.49	0.68
Max		33.9	5.92	226	113	26.00	6.59	6.13	1.84	35.16	14.64	68.88	1.67
Mean		29.78	5.36	65.85	32.55	5.91	2.05	1.36	0.52	5.57	7.45	16.28	1.00
Standard Deviation		1.54	0.33	75.03	37.59	7.28	2.38	1.45	0.58	7.84	3.03	22.82	0.24
WHO(2018) Standard		6.5-8.5	6.5-8.5	400	500	200	20	100	50	250	200	45	250